

the world, and find in every instance *only three* tentacles present, and *always similarly located*. One is at the posterior end of the slit at the junction of the two margins just over the anus, and I believe would be protruded from the last open perforation, or, in other words, that most remote from the lip of the shell. The second is situated well forward on the left margin of the slit, and doubtless would, when the animal was living, occupy the last-completed opening. The third is on the right margin somewhat further back, and, judging by the distance which separates it from the preceding tentacle, probably would be extruded through the second perforation.

Philippi, in his 'Handbuch der Conchyliologie' (p. 215), states that the animal thrusts through the holes the tentacular prolongations of the left side of the foot. This, however, is an impossibility, as the examination of any species at once shows, and possibly was merely a conclusion derived from the appearance of Cuvier's or some other figure.

LVIII.—*Professor Blake and Shell-growth in Cephalopoda.*

By F. A. BATHER, B.A.

IN the 'Annals' for April (p. 298) a paper on shell-growth in Cephalopoda was published, in which I described certain facts that appeared inconsistent with the views of Dr. Riefstahl and others. From facts first published by Drs. Riefstahl and Appellöf, but verified and extended by my own observations, I ventured to draw a few conclusions and to suggest an explanation which was avowedly theoretical. Prof. Blake ('Annals,' May, p. 376) has been good enough to criticize my paper without delay. Unfortunately misconception on all sides necessitates a reply. His remarks dealing with questions of priority and trustworthiness must be kept distinct from those dealing with facts and the conclusions based thereon. I first reply to the former; for if a man is proved ignorant of previously published results and guilty of substituting fancy for fact, his credit as a scientific worker is destroyed.

There is no doubt that readers of Prof. Blake's article understood him to mean that, so far as facts were concerned, I had said nothing new. This they inferred from such sentences as "Nor do I find that these writers have anything definite to

add," and from the last paragraph but one:—"Although therefore a new student of the Cephalopoda is to be welcomed . . . it would be better that such a one should take up the story where others have left it than go over the old ground with preconceived theories and less careful observations. Nothing, in fact, in the present communication is new; though it may be little known, it was all in print six years ago.

"I am not at all sure, however, that the suggestion &c."

In consequence of these sentences I wrote to Prof. Blake and asked for references to any papers in which the facts brought forward by Riefstahl and myself had been described. He replied with promptness, and kindly permits me to make use of his letter. He writes, "Nor do I say that what you have said was all in print six years ago, but what *I said*." We must therefore presume that Prof. Blake admits the originality of my observations, despite the contrary impression produced by his paper.

What Prof. Blake does say is that the description of the structure of the Nautilus-shell contained in his Monograph is opposed to some of my conclusions, of which description, he adds, I "seem to be ignorant." Those who know his admirable work will understand the damaging nature of this innuendo. Reply is of course impossible; but, as I gather from Prof. Blake's letter that he infers my ignorance of his work from the fact that I do not refer to it in what he is pleased to call my "Bibliography," I may point out that a list of "Papers and Works referred to" in the course of an article need not be a bibliography. Clearly mine was not: I mentioned neither the great work of Barrande, nor the articles in 'Science Gossip' by Mr. H. E. Quilter, nor Prof. Seeley's suggestive paper in *Quart. Journ. Sci.* (1864, p. 760), nor—but I might fill pages with references to papers on this subject, with which Prof. Blake must be better acquainted than I am, but to which he has nowhere alluded.

Ignorance of Prof. Blake's writings, though it might handicap, could not disqualify my work. More serious is his constant uncertainty as to whether what I say is "from autopsy or mental conception." Much as I regret this, I can but state that when I refer to definite specimens, or when I give "figures drawn to nature," I hope for some credence; when, on the contrary, I propose an explanation and invariably speak of it as "a theory" or "a view," I do not mean to assert it as a fact.

I pass with relief to Prof. Blake's discussion of facts and arguments; and here I am glad to find so much agreement.

So far as *Sepia* is concerned, Prof. Blake tacitly admits not only the originality but the correctness of the observations made by Riefstahl and myself. Where I differ from Riefstahl as to the facts, and in the inferences based on those facts with regard to *Sepia*, he also gives me his support. This support is valuable, for Prof. Blake knew all that we have discovered about the hard parts six years ago. All students will regret that his observations were never published. Prof. Blake apparently accepts the view that successive chitinous membranes are given off by the body-surface and subsequently calcified (a view which I claimed to defend rather than originate), and he joins me in ascribing to this process the formation of nacreous layer and septum. This view differs from that advocated in Blake's *Brit. Foss. Ceph.* p. 19, lines 23-27; it gives me pleasure to suppose that Prof. Blake's change of opinion is partly due to my new facts and arguments.

Prof. Blake denies "that in a *Nautilus* the earlier septa are approximate, the middle ones far apart, and the later ones approximate again." It is hard to see how this meaning can be extracted from my sentence, viz. "In the *Nautiloidea* the septa are still [*i. e.* at the present day] far apart, but approach in old age"; and I have repeatedly verified the remarks on p. 30 of his Monograph. Although he there says nothing as to the relations of the septa in the young uncompleted shell, he need not suppose that I thought his observations "too partial to be of value"; there was simply no occasion to allude to them.

I proceeded to say that the *Ammonoidea* soon differed from the forms with approximate septa which Hyatt, Foord, and others regard as archaic:—"So early as the *Goniatites* the septa are far apart in proportion to the diameter of the whorl." Prof. Blake (who seems to place all *Goniatites* in one genus) reminds me that *G. sagittarius* of the Devonian has very close-set septa, and asks if I can then maintain my statement. Certainly! I did not say "in all *Goniatites*" or even "in most *Goniatites*." The septa in one species may be ever so crowded; this does not affect the septation in other species, in other genera, in other subfamilies. Prof. Blake cannot be guilty of so obvious a fallacy in logic; he merely misunderstood the statement.

Finally, Prof. Blake approves the suggestion to divide the Cephalopoda into three orders, dropping the old terms *Tetrabranchiata* and *Dibranchiata*.

These orders are:—(i.) *NAUTILOIDEA*, Cephalopoda in which the protoconch is not preserved, although coiling takes place:

(ii.) AMMONOIDEA, Cephalopoda in which the protoconch is preserved by shell-coiling and comes to be affected thereby :
 (iii.) COLEOIDEA, Cephalopoda in which the protoconch is typically preserved by an external sheath deposited by the mantle ; the shell comes to be enveloped by the mantle, and may partly, even wholly, disappear. The name Coleoidea (*κολεός*, sheath) is congruous with the other two already in use.

The main points, then, have the very welcome support of Prof. Blake ; there are, however, two which he has severely criticized :—(i.) the suggestion that the membranes of the septa are typically continuous with those of the shell-wall ; (ii.) the theoretical assumption that the lamellæ of *Sepia* are homologous with the septa of a Belemnite-phragmocone.

(i.) A supposition on which no argument is based may well be described as “imaginary.” But Prof. Blake’s manner of controverting the hypothesis is open to much objection. He writes (‘Annals,’ p. 377), “if Mr. Bather had availed himself of my observations of the shell of *Nautilus* . . . he could not have written as he does.” Then follow two paragraphs which distinctly profess to be an abstract of p. 17 *et seq.* of Prof. Blake’s Monograph. Whether the statements of Prof. Blake in the ‘Annals’ are in accordance with fact I do not for the moment inquire ; it is enough to show that they do not harmonize with the statements of Prof. Blake in the Monograph. Prof. Blake (‘Annals’) states that the outcropping edges of the fine laminae are 20,000 to the inch : this statement is not in the Monograph ; on the contrary, from pl. ii. fig. 8 of that work it appears that Prof. Blake’s “outcropping edges” are 4000 to the inch, 2800 in fig. 7, while in the earlier chambers they can be “seen under a low power,” and are drawn in pl. ii. fig. 5 at about 450 to the inch. The slight curvature of the shell cannot explain the discrepancy. Next, Prof. Blake (‘Annals’) states that the obliquity of these laminae “is very slight, so that in tracing them from their commencement inside to their termination against the outer layer of the shell, they pass more than one septum” : this statement is not in the Monograph, nor can it be inferred from the figures ; on the contrary, in pl. ii. fig. 1 oblique lines are seen to pass from the inside to the outside within the space between two septa. Lastly, Prof. Blake (‘Annals’) states that the shell is composed of three layers, and that “the third layer is a thin amorphous substance covering the whole of the interior of the shell . . . In the later portion of the shell . . . it is seen *between the septum and the shell*, completely sepa-

rating the two structures": this statement is not in the Monograph; on the contrary, there will be found on p. 19 this description:—"Besides these two layers there is a third, lining the interior of the shell. This is of very small thickness, and consists of similar laminae to the nacreous layer, &c." The word "amorphous" is usually taken to mean "without structure."

Prof. Blake's descriptions are clearly inconsistent with one another. He did not suppose that I had made observations for myself. I have done so. And I am bound to add that both of his descriptions are inconsistent with the facts. We must suppose that his statements of this year are intended to supersede those of 1882: let us consider them. He says, "The outcropping edges of" the fine laminae are "about 20,000 to the inch." He says of these laminae, "their obliquity is very slight, so that . . . they pass more than one septum." It is seen by measuring the distance from suture to suture in a Nautilus-shell that, to fulfil the latter condition, each lamina must be from 1 to 3 inches long. It is therefore obvious that, to fulfil the former condition, there must be from 20,000 to 60,000 such laminae in the thickness of the nacreous layer. And yet, as Prof. Blake correctly says, "about 1000 fine laminae may be counted in its thickness."

Prof. Blake's statement, on which he rests much of his subsequent argument, that iridescence is here caused by diffraction of light due to outcropping edges of laminae (*i. e.* diffraction by a reflexion-grating), is based presumably on the theory of Brewster; reference to the original paper (Phil. Trans. 1814, p. 397) will show that this, though the ordinary reading of it, is both incorrect and incomplete. In his Monograph Prof. Blake brushes aside the contrary conclusions of Dr. W. B. Carpenter without a reference to the elaborate arguments of that most accurate observer (see Brit. Assoc. Rep. 1844, p. 11). I do not here commit myself to any view, but examination of sections and shell-surfaces has convinced me that the cause to which Prof. Blake ascribes the observed phenomena is absolutely insufficient. For example, in the most iridescent part of the shell the lines of outcrop are furthest apart, and iridescent surfaces are seen between them. To maintain his assertion Prof. Blake is compelled to say that the septa are not iridescent. Nautilus-shells are not rare; but I have never yet seen one that confirms this last statement.

Let us now consider "the third layer." This was not described as amorphous by Hyatt (Bull. Mus. Comp. Zool. iii. p. 105, 1872) or by Blake (Brit. Foss. Ceph. p. 19, 1882).

The latter, it is true, said: "In the acute angles made by the junction of the septa with the circumference of the shell is another deposit, less transparent than the nacreous layer, but showing very little structure." It seems as though Prof. Blake were now confusing this with the "third layer." But his Monograph distinctly leads one to understand that this deposit does *not* pass between the septum and the shell. He mentions also "a loose amorphous deposit" lining each septum on either side, apparently continuous with that filling the angles. The fact is that all these deposits are of the same essential structure as the nacreous layer and septa. The constituent membranes are less compressed in the angles, but they become compressed and pass between the septum and the previously formed portion of shell-wall. They are, however, united with the septal and shell membranes on either side by transverse chitinous connexions; these appear to be the walls of what Prof. Blake calls "lacunæ"; they pass right into the nacreous layer and into the septum. There is therefore organic connexion between the septum and shell-wall in Nautilus, just as Riefstahl first described in Sepia. I confess that in my explanation ('Annals,' p. 306) I expressed myself too definitely; the credit of pointing this out is due to Prof. Blake, but it will be understood that there was nothing in his previous description to conflict with my idea, and that his present statements are too incorrect to influence the same. The following alteration of my previous paper (*ib.* p. 306) is based on my own observations; the altered words are in italics:—"On the surface of the cells that coat the visceral hump a layer of chitin * is, by concrecence of their distal portions, continually formed, and from it the membranes are, as it were, exfoliated. Secretion begins in the anterior region of the shell-wall, *and* proceeds backwards to the suture, thence centripetally over the septum to the posterior margin of the septal neck. *The chitin* of the septum is *essentially* one with *the chitin* of the shell-wall. *Probably before, but possibly in consequence of, calcification* † *this chitin splits into membranes (vide suprà)*. Lime is deposited as arragonite upon and between these membranes soon after their secretion; nacre is produced by this more purely physical process, *not by direct secretion.*" I hope that this theoretical explanation will satisfy Prof. Blake, and I must thank him for affording me an opportunity of making the correction.

* *Chitin*, more correctly *conchiolin* (see footnote, p. 303).

† See Osborn, Stud. Biol. Lab. Johns Hopkins Univ. ii. p. 427 (1883).

(ii.) Some of my arguments depend, as Prof. Blake points out, on the homology of the lamellæ in the pad of *Sepia* with the septa in the Belemnite-phragmocone. This homology is doubted by Prof. Blake, who now suggests that the lamellæ of the pad are homologous with the calcified membranes of the nacreous layer in the shell-wall of *Nautilus*. His arguments are three. He claims first that his observations on shell-structure do not countenance my view: my readers will decide whether Prof. Blake's description is valid evidence one way or the other. He states secondly that the lamellæ of *Sepia* "have no siphuncle, and they are not even perforated:" now each later-formed lamella is like an elliptical figure with the posterior part cut away by another broader ellipse; the earlier lamellæ are of more circular outline, but are similarly incised; if this incision represents the siphuncular space, then from this form to the form of the septa in *Belosepia* is a mere step; even in the Belemnite the siphuncle is so external as hardly to be surrounded by the septum. Lastly, he states that there is no trace of a "cap" or of a protoconch in *Sepia*: the explanation of this was given by Prof. Lankester in his "Observations on the Development of Cephalopoda" (Q. J. M. S. xv. p. 37) in 1875, and to the arguments of that authority no opposition has hitherto been offered.

The view taken by me as to the homologies of the Sepion was first put forward by Voltz (Mém. Soc. Hist. Nat. de Strassbourg, i. p. 1) in 1830; I am not aware that his arguments have ever been refuted; the view is adopted by Prof. Gegenbaur in his well-known text-book; it has been confirmed by recent observations, and, though I arrived at it independently from a study of the facts, I had no wish to retell an old tale.

I accept with gratitude the support and welcome of Prof. Blake, and only regret that his article should necessitate a reply so full of controversy. For this I apologize to the readers of the 'Annals,' but would remind them of the Rabbinical proverb, "By the contention of students science is advanced."

LIX.—*Descriptions of two new Species of Indian Soricidæ.*
By G. E. DOBSON, M.A., F.R.S.

As Mr. W. T. Blanford is about to print his work on the mammals of British India, and is anxious to include every known species from that region, he has requested me